TEXTILE RESEARCH

Publication of

United States Institute for Textile Research, Inc.

CHARLES H. CLARK, *Managing Editor,*

Publication Office: Prince and Lemon Sts., Lancaster, Pa.

Editorial and General Offices: 65 Franklin St., Boston, Mass.

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Vol. VII **September, 1937** **No. 10**

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Entered as second-class matter, November 17, 1932, at the Post Office at Lancaster, Pa., under the Act of Congress of March 3, 1879.

Issued monthly at Prince and Lemon Streets, Lancaster, Pa., for United States Institute for Textile Research, Inc., Boston, Mass.
Made in United States of America.

Subscription price $5.00 a year. Single copies .50.

The Editor's Page

Financial Sponsors of Drying Research

THE honor list to date of textile and allied firms, whose financial co-operation has made possible the conduct at the National Bureau of Standards of U. S. Institute's research on textile drying, is as follows:

American Enka Corp., Enka, N. C.
American Woolen Co., New York, N. Y.
Andrews & Goodrich, Inc., Boston, Mass.
Apponaug Co., Apponaug, R. I.
Arlington Mills, Lawrence, Mass.
Bigelow-Sanford Carpet Co., Thompsonville, Conn.
Sidney Blumenthal & Co., New York, N. Y.
Bristol Co., Waterbury, Conn.
Brown Instrument Co., Philadelphia, Pa.
H. W. Butterworth & Sons Co., Philadelphia, Pa.
Celanese Corp. of America, New York, N. Y.
Collins & Aikman Corp., Philadelphia, Pa.
Continental Mills, Inc., Philadelphia, Pa.
Delaware Rayon Co., New Castle, Del.
E. I. du Pont de Nemours & Co., Rayon Div., Buffalo, N. Y.
Eavenson & Levering Co., Camden, N. J.
Ewing-Thomas Corp., Chester, Pa.
Firth Carpet Co., Auburn, N. Y.
Forstmann Woolen Co., Passaic, N. J.
Foxboro Co., Foxboro, Mass.
Frankford Worsted Mills, Inc., Philadelphia, Pa.
Globe Dye Works, Philadelphia, Pa.
Hampton Co., Easthampton, Mass.
Hardwick & Magee Co., Philadelphia, Pa.
Hellwig Silk Dyeing Co., Philadelphia, Pa.
James Hunter Machine Co., North Adams, Mass.
Charles B. Johnson, Paterson, N. J.
Charles Lachman Co., Philadelphia, Pa.

James Lees & Sons Co., Bridgeport, Pa.
Mohawk Carpet Mills, Inc., Amsterdam, N. Y.
Mount Hope Finishing Co., North Dighton, Mass.
National Drying Machinery Co., Philadelphia, Pa.
North American Rayon Corp., Elizabethton, Tenn.
Pacific Mills, Boston, Mass.
Parks-Cramer Co., Fitchburg, Mass.
Philadelphia Drying Machinery Co., Philadelphia, Pa.
Proctor & Schwartz, Inc., Philadelphia, Pa.
J. O. Ross Engineering Corp., New York, N. Y.
C. G. Sargent's Sons Corp., Graniteville, Mass.
Alex. Smith & Sons Carpet Co., Yonkers, N. Y.
Taylor Instrument Companies, Rochester, N. Y.
Tennessee Eastman Corp., Kingsport, Tenn.
Tubize Chatillon Corp., New York, N. Y.
U. S. Hoffman Machinery Corp., Syracuse, N. Y.
United Merchants & Manufacturers Management Corp., New York, N. Y.
Uxbridge Worsted Co., Uxbridge, Mass.

A total of fifty sponsors at $100 each is needed to complete the financing of the study for its first year, but there is no limit to the number of co-operators, and should sufficient additional funds be subscribed progress of the work may be aided materially. The first monthly progress report of the study, descriptive of special equipment designed for studying moisture relations of textile materials in air at different relative humidities at elevated temperatures, was mailed to co-operators last month. Future subscribers to the project will qualify to receive all progress reports. For full particulars regarding this research see the descriptive booklet, "Drying," copy of which may be had by addressing Secretary, U. S. Institute for Textile Research, 65 Franklin St., Boston, Mass.

An Appreciated Endorsement

U. S. INSTITUTE'S research on warp sizing and sizing materials, now in its third year, has received a grant of $500 from a manufacturers' association; no, not a textile manufacturers' association, but the Corn Industries Research Foundation, a research organization supported by all of that industry's leading manufacturers. The following four corn starch producers have been financial co-operators of the warp sizing study from its start in 1935: Corn Products Sales Co., Keever Starch Co., Penick & Ford, Ltd., and A. E. Staley Manufacturing Co. The other members of the Foundation are as follows: American Maize-Products Co., Anheuser-Busch, Inc., Clinton Co., Hubinger Co., Huron Milling Co., Inc., Piel Bros. Starch Co., Union Starch & Refining Co. This appreciated grant followed an investigation of the status of the warp sizing study by the director of the Corn Industries Research Foundation. Associations of domestic manufacturers of gelatins, potato starch and other sizing materials please take notice!

* * *

Report on Rayon Crêping Problems

THE research on rayon crêping problems conducted jointly by the Throwsters Research Institute and the American Association of Textile Chemists and Colorists, and financed by them with the aid of the Textile Foundation, has been completed, and final reports will be published in the *American Dyestuff Reporter* starting with the Quarterly Research Number in October. Difficulties involved in placing responsibility for visible variations in finished crêpe fabrics, and for claims resulting therefrom, inspired the organization of the study. It has involved an exhaustive survey and analysis of materials and processes from the yarn to and including the finished fabrics. The results should indicate the most satisfactory materials and processing for a desired result, even though such fundamentals as the theory of crêping must await further research. A start was made on the latter subject by R. L. Steinberger, a Textile Foundation Fellow, at the suggestion of U. S. Institute's Research Council, and resulted in his report on "Torque Relaxation and

(*Continued to P. 424.*)

Microbiology of Textile Fibres

VI. Relative Humidity over Certain Aqueous Solutions of Glycerol at 25° C.

By BRYCE PRINDLE*

Summary

A dew point apparatus was devised for measuring the humidity over aqueous solutions of non-volatile substances. Preliminary experiments proved that results obtained with the instrument were reproducible and that it could be used to make dependable measurements of the relative humidity over such solutions in the range of from 70% to 90% at 25° C.

Dew point determinations were made on a series of glycerol solutions having aqueous tensions corresponding to from 70% to 95% relative humidity at 25° C. The experimental data are critically compared with previously published figures.

Introduction

IN the course of experiments on the development of mildew organisms in raw cotton it became necessary to hold small samples at constant temperature and humidity. The most convenient method of doing this was to enclose the test material in a sealed container with a conditioning agent of known aqueous tension. A study of the properties of available materials led to the conclusion that aqueous solutions of glycerol would be the most useful.

An extensive review of the literature was made in an effort to obtain accurate relative humidity data for such solutions. Two sets of data were found for the temperature of 25° C., which was the temperature to be used in the mildew experiments. One (1931, Carson) was in terms of relative humidity; the other (1928, National Research Council) was given in terms of vapor pressure of water. When the latter was converted to terms of relative humidity and the two compared, a considerable disagreement became apparent. The difference in values was great enough to make the data useless as a basis for formulating the desired conditioning solutions.

Because of the superiority of glycerol solutions for use in the type of experiment which had been planned, and because it was thought that ac-

* Dr. Prindle, as a Senior Fellow of the Textile Foundation, worked under the direction of Prof. Samuel C. Prescott, Massachusetts Institute of Technology, Cambridge, Mass.

This is Contribution No. 102 of the Department of Biology and Public Health, Massachusetts Institute of Technology, Cambridge, Mass.

curate information on this subject would be useful in other laboratory investigations involving humidity control, apparatus was devised, and a third set of data was derived.

Aqueous tension was measured by a dew point method, and a series of determinations were made on glycerol solutions yielding relative humidities of from 70% to 95% at 25° C.

Apparatus

The instrument used for making the above measurements is a modification of apparatus which has been previously described by Bates and Highlands (1934) and by Fuller (1935). It was designed to measure the temperature of the dew point and of a test liquid to 0.01° C. In the investigation described in this paper, it was used to make such measurements to an accuracy of 0.1° C.

Fig. 1 is a picture of the apparatus. As may be observed, the body

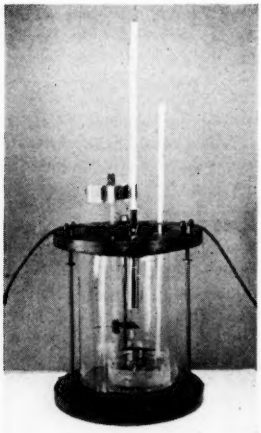

FIG. 1. Dew point Apparatus.

consists of a glass battery jar, which can be sealed at the top by means of a rubber-faced disk supported by wooden rings. The wooden rings can be tightly screwed down by butterfly nuts threaded onto brass rods. A crystallizing dish inside the battery jar serves to hold the solution under test. Through the top are thrust a stirring device and the measuring instruments. The shaft of the former is a glass rod. One end of this is flattened to serve as a paddle for stirring liquid. A few centimeters above this end, a propeller of aluminum is mounted by means of a cork. A coating of paraffin wax serves as protection for these parts. The glass shaft passes to the external atmosphere through a glass tube which serves as a bearing and seal. A small air turbine is used to rotate the moving parts.

Temperatures are measured by means of calibrated 30° C., 3 inch, immersion, fractional thermometers. One of these is immersed in the test solution; the other is sealed into the dew point bulb. The dew point bulb of chromium plated copper is in turn held tightly in the top of the jar with a rubber stopper.

When in use, this apparatus was held at constant temperature in a 25.0° C. air thermostat. Cooling of the dew point bulb is accomplished by evaporation of ethyl ether.

Methods

Glycerol solutions for use in this work were made up from chemically pure glycerol and distilled water. A solution of approximately correct concentration was first made up by weight. The exact composition was then determined by means of specific gravity measurements to the fourth significant figure.

In attempting to keep several of the more dilute glycerol solutions over long periods of time at room temperature, they were observed to become moldy. Several common antiseptics were tested in samples of dilute glycerol. Salicylic acid in the proportions of 0.1 gram to 100 cc. of solution was found to be an efficient preservative.

Determination of the dew point over a solution was carried out in the following manner:

1. The dew point apparatus containing the solution was placed in the air thermostat and allowed to come to 25.0° C.

2. The test solution and air in the humidity chamber were then placed in a state of violent agitation and the measurement of dew points begun. Each complete dew point measurement consisted of three thermometer readings; one was the temperature of the test solution, one the temperature at which dew first appeared on the chromium plated bulb, and the third the temperature at which the dew disappeared. All of these readings were made to an estimated 0.01° C.

3. A series of seven dew point determinations was made on each solution.

4. The average of the above dew point measurements was taken as the true dew point and relative humidity computed from it.

Calibration of Apparatus and Testing of Methods

Thermometers.—The measurement of primary interest in this work was the measurement of the *difference* in the temperature of the test solution and the temperature of the dew point. As this could only be accomplished by the use of two standard thermometers, it was necessary to compare their readings minutely at temperatures over the range to be used. They were, therefore, set up in a violently agitated water bath side by side, each immersed at the depth at which it was to be used and readings to 0.01° C. were made at one degree intervals over the entire range of 16 to 25° C. All of the readings of one thermometer were duplicated by those of the other.

Reproducibility of the Dew Point Determination.—In making dew point determinations previously, it was noted that the relative humidity of approximately 85%, at 25° C. was difficult to measure. A solution of

41% by weight of glycerol in distilled water was therefore tested three times to determine the accuracy of the newly devised apparatus and method. The data derived from determinations are given on the pages following. When converted to terms of relative humidity the dew point measurements all agree at 86%.

Note: Throughout this work, the terms Dew Point and Relative Humidity were used in accordance with the definitions given in the International Critical Tables. These definitions are quoted below with a sample computation in which the figures from Table I are used as an example.

Dew Point.—"Dew point of a gas is the temperature at which the pressure of water vapor in equilibrium with water is equal to the actual pressure of the water vapor in the gas."

Relative Humidity.—"Relative humidity of a gas = ratio of the pressure of water vapor present to the pressure of water vapor which is in equilibrium with water at the same temperature."

Computation:

Temperature of Test Solution, 25.04° C.
Temperature of Dew Point, 22.51° C.
Vapor pressure of water at 25.0° C., 23.8 mm. Hg
Vapor pressure of water at 22.5° C., 20.4 mm. Hg

$$\frac{20.4}{23.8} \times 100 = 85.7\% \text{ Relative Humidity.}$$

A further test of the accuracy of the dew point method was made by testing solutions of sulphuric acid, which have been extensively used in regulating humidity in the past and for which accurate data are available. The results of this test are given on the following pages. They demonstrate conclusively that the dew point method employed will serve to measure the relative humidity over sulphuric acid solutions to a degree of accuracy which compares well with the average of data from three independent, authoritative sources.

Having proven the usefulness of the methods devised, the experimental program for the determination of relative humidities over glycerol solutions was begun.

TABLE I

Dew Point Over Aqueous Solution

Solution

Composition: Glycerol in water plus 0.1 gm./100 cc. salicylic acid.
Specific Gravity 20/4° C.:

Weight Percentage of Solute, 41

TABLE I—*Continued*

Dew Point Determination

Solution Temp. °C.	Dew Point °C. Dew On	Dew Off
25.04	22.41	22.55
25.04	22.44	22.54
25.04	22.44	22.58
25.04	22.43	22.54
25.04	22.46	22.55
25.05	22.45	22.58
25.05	22.43	22.58
Average 25.04	22.51	

Average:
Temperature of the Solution, 25.04° C.
Temperature of the Dew Point, 22.51 "

Difference, 2.53 "
Relative Humidity, 85.7%

TABLE II

Dew Point Over Aqueous Solution

Solution

Composition: Glycerol in water plus 0.1 gm./100 cc. salicylic acid.
Specific Gravity 20/4° C.:

Weight Percentage of Solute, 41

Dew Point Determination

Solution Temp. °C.	Dew Point °C. Dew On	Dew Off
25.02	22.43	22.57
25.01	22.43	22.57
25.02	22.50	22.58
25.02	22.47	22.60
25.02	22.48	22.58
25.01	22.48	22.57
25.01	22.50	22.58
Average 25.02	22.52	

Average:
Temperature of the Solution, 25.02° C.
Temperature of the Dew Point, 22.52 "

Difference, 2.50 "
Relative Humidity, 86.0%

TABLE III

Dew Point Over Aqueous Solution

Solution

Composition: Glycerol in water plus 0.1 gm./100 cc. salicylic acid.
Specific Gravity 20/4° C.:

Weight Percentage of Solute, 41

Dew Point Determination

Solution Temp. °C.	Dew Point °C. Dew On	Dew Off
25.02	22.45	22.56
25.02	22.42	22.58
25.02	22.50	22.55
25.02	22.48	22.60
25.02	22.47	22.57
25.03	22.48	22.60
25.04	22.50	22.62
Average 25.03	22.53	

Average:
Temperature of the Solution, 25.03° C.
Temperature of the Dew Point, 22.53 "

Difference, 2.50 "
Relative Humidity, 86.0%

TABLE IV

Dew Point Over Aqueous Solution

Solution

Composition: Reagent sulphuric acid in water.
Specific Gravity 20/4° C., 1.239

Wt. sp. gr. bottle & sample: 67.24 grams
Wt. sp. gr. bottle, 36.00 "

Wt. sample, 31.24 "

$$\frac{\text{Weight of sample}}{\text{Vol. Sp. Gr. bottle 20° C.}} = \frac{31.24}{25.20}$$

Weight Percentage of Solute, 32.5

TABLE IV—*Continued*

Dew Point Determination

Solution Temp. °C.	Dew Point °C. Dew On	Dew Off
25.00	19.14	19.26
25.00	19.15	19.25
25.00	19.17	19.30
25.01	19.16	19.30
25.01	19.15	19.28
25.01	19.20	19.27
25.00	19.18	19.28
Average 25.00	19.22	

Average:

Temperature of the Solution, 25.00 °C.
Temperature of the Dew Point, 19.22 "

Difference, 5.78 "
Relative Humidity, 70.3%

TABLE V

Dew Point Over Aqueous Solution

Solution

Composition: Reagent sulphuric acid in water.
Specific Gravity 20/4° C.: 1.199

Wt. sp. gr. bottle & sample: 66.22 grams
Wt. sp. gr. bottle, 36.00 "

Wt. sample, 30.22 "

$$\frac{\text{Weight of sample}}{\text{Vol. Sp. Gr. bottle 20° C.}} = \frac{30.22}{25.20}$$

Weight Percentage of Solute, 27.5

Dew Point Determination

Solution Temp. °C.	Dew Point °C. Dew On	Dew Off
25.00	20.88	21.00
25.00	20.87	21.00
25.00	20.88	20.97
25.00	20.87	21.00
25.00	20.90	21.00
25.00	20.92	20.98
24.99	20.92	20.97
Average 25.00	20.94	

Average:

Temperature of the Solution, 25.00° C.
Temperature of the Dew Point, 20.94 "

Difference, 4.06 "
Relative Humidity, 78.2%

TABLE VI

Dew Point Over Aqueous Solution

Solution

Composition: Reagent sulphuric acid in water.
Specific Gravity 20/4°C.: 1.130

Wt. sp. gr. bottle & sample: 64.48 grams
Wt. sp. gr. bottle, 36.00 "

Wt. sample, 28.48 "

$$\frac{\text{Weight of sample}}{\text{Vol. Sp. Gr. bottle 20° C.}} = \frac{28.48}{25.20}$$

Weight Percentage of Solute, 18.75

Dew Point Determination

Solution Temp. °C.	Dew Point °C. Dew On	Dew Off
24.99	22.90	23.10
24.99	22.90	23.07
25.00	22.90	23.05
25.00	22.90	23.05
25.00	22.93	23.04
25.00	22.92	23.05
25.00	22.94	23.02
Average 25.00	22.98	

Average:
Temperature of the Solution, 25.00° C.
Temperature of the Dew Point, 22.98 "

Difference, 2.02 "
Relative Humidity, 88.8%

TABLE VII

Relative Humidity Over Aqueous Solutions of Sulphuric Acid at 25° C.

Concentration of H_2SO_4 in Wt. %	Relative Humidity %			
	International Critical Tables	Physikalisch-Chemische Tabellen	Wilson	Experimental
0	100	100	100	100
5	—	—	98.5	—
10	94.2	96	96.1	—
15	—	—	92.9	—
18.75	—	—	—	88.8
20	87.5	88	88.5	—
25	81.7	—	82.9	—
27.5	—	—	—	78.2
30	74.8	75	75.6	—
32.5	—	—	—	70.3
35	66.5	—	66.8	—
40	—	67	—	—

Experimental Procedure

(a) A series of pure glycerol solutions were prepared by weight measurements. These were planned to yield a series of solutions capable of maintaining the following relative humidities at 25° C.: A, 95%; B, 93%; C, 90%; D, 85%; E, 80%; F, 75%; G, 70%.

(b) The composition of these solutions was then determined accurately by means of specific gravity measurements.

(c) Relative humidity determinations were then carried out on each solution in accordance with the method outlined above.

(d) Salicylic acid was added to each of the solutions in the proportions of 0.1 gram to each 100 cc. of soln.

(e) Specific gravity determinations and relative humidity measurements were then repeated on all solutions.

Experimental Results

The results of this work are presented briefly in Table VIII.

TABLE VIII

% Relative Humidity Over Aqueous Glycerol Solutions at 25° C.

% Glycerol by Wt.	Glycerol in H_2O	Solution + Salicylic Acid	Int. Crit. Tables	Carson
15.5	—	—	97.2	—
19	94.8	94.7	—	—
25	92.7	92.7	92.6	—
33	89.7	89.7	—	90
35	—	—	85.2	—
41	85.5	—	—	—
48	82.2	82.1	—	—
50	—	—	73.4	—
51	—	—	—	80
56	76.2	76.2	—	—
60	—	—	62.4	—
63	71.2	71.2	—	—
64	—	—	—	70

Discussion

The first point of interest to be derived from the above experimental work is the fact that the dew point apparatus effectively demonstrated its value in making accurate measurements of water vapor pressure over solutions of non-volatile solutes. The triplication of a relative humidity measurement of 86% at 25° C. is in itself a demonstration that results reproducible with a high degree of accuracy can be obtained.

The measurements obtained in the case of sulphuric acid solutions cannot be directly compared with those published by other investigators because solutions of equal concentrations were not used. As it is theoretically

reasonable to suppose, and has been experimentally demonstrated, however, the relative humidity over sulphuric acid solutions at any given constant temperature varies continuously with progressive increase or diminution in concentration of the same. The whole relationship between concentration of sulphuric acid solutions and the relative humidity over them at any given temperature can therefore be expressed as a two dimensional graph. This was done in Fig. 2. The three measurements obtained in this work are compared with a plot of the arithmetical averages of figures quoted in three authoritative sources.

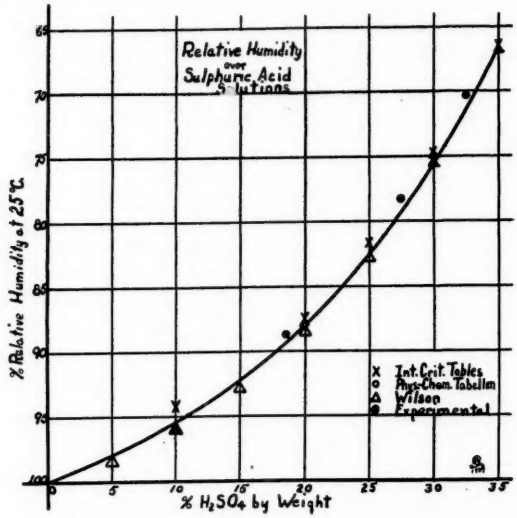

FIG. 2.

The graphical comparison made in the above manner indicated that all of the points established by dew point measurement are within approximately 0.5% relative humidity of the values indicated by the curve. In view of this close agreement, and the high degree of reproducibility of the data, the error of measurements made in the course of the experimental work discussed in this report can be conservatively stated to be not more than plus or minus 1.0% relative humidity.

A glance at the dew point data obtained in the case of glycerol solutions is sufficient to show that the addition of 0.1 gram of salicylic acid to each 100 cc. of solution did not materially change either the specific gravity or the dew point measurement in any case.

In Table VIII and Fig. 3, the experimental data for glycerol solutions is compared with two other sets of data independently derived. A great disparity is at once apparent between the new values and those cal-

culated from vapor pressure data given in the International Critical Tables (1928, National Research Council). Reference to the original publication (1910, Drucker & Moles) of this data provided no explanation for this disagreement. In the case of data taken from an article by Carson (1931), a very close agreement is apparent.

Because of the fact that the two sets of data which agree have been more recently derived, and because the differences observed are very much greater than the 1% relative humidity, which has been shown to be the

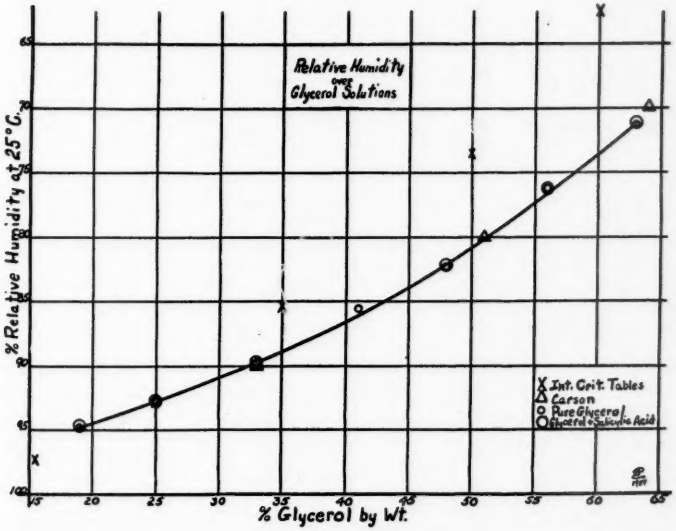

FIG. 3.

maximum error of the dew point apparatus, it is concluded that the dew point data derived in this research is a true measure of the relative humidity over glycerine solutions.

Conclusions

1. The dew point apparatus devised and used according to the method herein described, was found to be a satisfactory means for measuring the relative humidity over solutions of non-volatile solutes to plus or minus 1% at 25° C.

2. The addition of 0.1 gram of salicylic acid to each 100 cc. of glycerine solution, was found to be an efficient preservative without appreciably changing the specific gravity or water vapor pressure of the solutions.

3. A set of data for the relative humidity over certain glycerol solutions at 25° C. was derived.

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(*Continued from P. 412.*)

Torsional Energy in Crêpe Yarn" (*Tex. Rsch.,* VII, 2, 85–102). It will be recalled that U. S. Institute aided the focusing of attention and interest on this crêpe project by its contribution of a largely attended conference on the subject in conjunction with its annual meeting in November, 1935.

* * *

A. A. T. C. C. Research Progress Reports

IN publishing the progress reports of its researches in a quarterly research number of the *American Dyestuff Reporter,* starting with the July 26th issue, the American Association of

(*Continued to P. 431.*)

X-Ray Analysis of Textile Fibres

Part V. Relation of Orientation to Tensile Strength of Raw Cotton

By WAYNE A. SISSON*

Summary

In a previous paper[5] describing an X-ray method for quantitative comparison of crystalline orientation in cellulose fibres, data were presented which suggested a relationship between orientation and the tensile strength of three commercial samples of cotton cord. Through informal co-operation with Dr. C. M. Conrad,[2] it was possible to further establish this relationship on ten specially selected samples of raw cotton varying widely in tensile strength.[3] A brief summary of the results, and a detailed description of the technique employed in obtaining the results are given in the present paper.

Introduction

THE samples investigated and their average tensile strength values obtained from ten breaks on the same sample, as furnished by Dr. Conrad, are listed in Table I. Values for the alignment of fluorescent dyes[2] and cuprammonium fluidity measurements[2] made on samples of the same cotton by other investigators co-operating with Dr. Conrad also are included in Table I. The ten samples were submitted in two different lots of four and six: the four samples, indicated by an asterisk in Table I, were used to calibrate the orientation values in terms of tensile strength; the six samples served as "unknowns." The four known samples were first photographed several times under various experimental conditions. Complete density measurements were made around the 002 diffraction ring,[5] and distribution curves calculated for each film. The correlation of this orientation data with the tensile strength values, made it possible to select the best X-ray experimental conditions. On the set of films showing the highest degree of correlation, various rapid methods for estimating the orientation directly from the film were tried, and three of the best methods selected to be used later in predicting the tensile strength of the unknown samples.

* Boyce Thompson Institute for Plant Research, Yonkers, N. Y.

[2] Division of Cotton Marketing, Bureau of Agricultural Economics, U. S. Department of Agriculture, Washington, D. C.

[3] The experimental work on these ten samples was completed while the writer, as a Senior Fellow of the Textile Foundation, worked under the direction of Prof. G. L. Clark, Department of Chemistry, University of Illinois, Urbana, Illinois.

TABLE I

Sample No.	Observed Chandler Strength	Calculated Chandler Strength	X-ray Diffraction	Dichroic Orientation	Cupram-monium Fluidity
	10^3 lbs./sq. in.	10^3 lbs./sq. in.	degrees[1]	per cent[2]	recip. poisés[3]
A*	111.9	109.0	24.2	—	—
11	105.0	111.1	23.2	18.8	3.50
57*	92.2	96.0	30.5	—	—
775757	92.0	88.6	34.1	16.3	3.54
68*	84.4	85.4	35.6	—	—
16	84.0	79.4	38.5	8.0	—
31	82.7	81.8	37.3	5.6	3.62
789031	80.0	81.5	37.5	8.2	—
54*	72.9	71.0	42.6	—	3.92
26	71.9	70.2	43.0	6.0	4.14

* Samples used for calibration.
[1] Angle at which density decreased to 40% of maxima.
[2] See literature citation.[3] The Chandler strength values listed by Morey[3] for the same samples differ from the values listed here which are based on a new calibration of the Testing Machine.[4]
[3] See literature citation[2]

The six unknown samples were photographed under two different experimental conditions—with and without tension applied to the bundle. Orientation values for the two sets of X-ray diagrams were then obtained by each of the three rapid methods, and the tensile strength estimated from the calibration data previously obtained from the four known samples. When the X-ray and tensile strength data for the six unknown samples were exchanged with Dr. Conrad, the strength estimated from the X-ray data showed a high degree of correlation with that determined experimentally by the Chandler bundle method.

A selected set of X-ray measurements (angle of 40% maximum density —samples photographed under tension), and the tensile strength values calculated from the X-ray measurements, are listed in Table I. The calculated strength values (S_c) were obtained by fitting a line between the X-ray angle (A) and the observed strength (S_o) data to the first four samples, and then with the equation for this line ($S_c = 159.07 - 2.068A$) calculating the theoretical strength for all ten samples. The values thus calculated are plotted against the experimentally obtained values in Fig. 1. The correlation coefficient is + 0.970.

The relationship between orientation and tensile strength was further tested on 21 other cotton samples.[4] The results for the samples photographed under tension are shown in Fig. 2, where the tensile strength values calculated from the X-ray data are plotted against the experimental values. The correlation coefficient is + 0.867. The strength values were calculated by fitting a line to the X-ray and tensile data for the 21 samples and calculating the theoretical strength from the equation for this line ($S_c = 190.69 - 2.9472A$).

[4] These 21 samples were photographed while the writer was associated with the Division of Cotton Marketing, U. S. Department of Agriculture. Appreciation is expressed to members of the Division for their co-operation in preparing the cotton samples and supplying the strength data; and especially to Dr. C. M. Conrad for his assistance in correlating the strength and X-ray data.

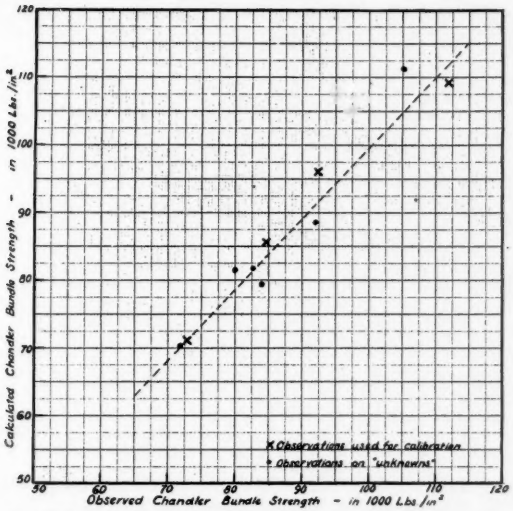
Calculated Chandler Bundle Strength - in 1000 Lbs/in²
Observed Chandler Bundle Strength - in 1000 Lbs/in²
X Observations used for calibration
• Observations on "unknowns"

FIG. 1. Relation between observed strength and strength calculated from X-ray data for 10 samples of raw cotton.

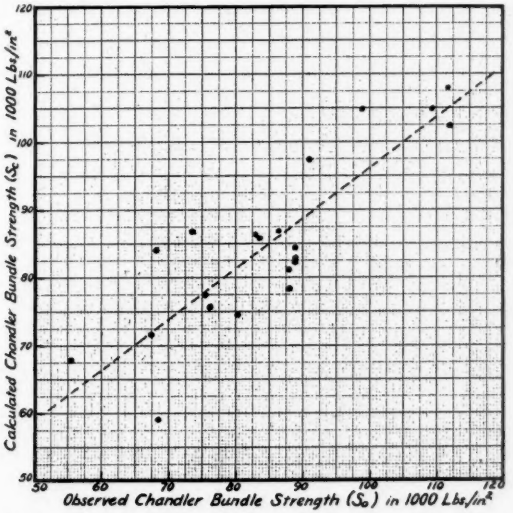

FIG. 2. Relation between observed strength and strength calculated from X-ray data for 21 samples of raw cotton.

Although the equations relating the X-ray orientation to the observed strength are slightly different for the two sets of samples, and the correlation between the calculated and observed strength is not as perfect for the 21 as for the 10 samples, these preliminary results indicate that, if the accuracy and speed of the X-ray method can be improved, it might be possible to measure orientation as a routine method for predicting certain elements of character and utility in raw cotton. Recently, further studies along this line at the Bureau of Agricultural Economics, U. S. Department of Agriculture in Washington, D. C., have been reported.[1]

Detailed Description of Methods

The X-ray method described elsewhere[5] for comparing the crystallite orientation of cellulose fibres depends upon a measurement of the density distribution around the 002 diffraction ring. The density readings around the ring are made possible by equipping a densitometer with a rotating stage. The density values taken every 5° or 10° are plotted as distribution curves which may be differentiated from one another by statistical methods. Since certain improvements and changes in the original general method have been made, it would seem appropriate at this time to describe in detail some of the special rapid methods which have been used for estimating the degree of orientation of the cottons described in the present study.

Preparation of Sample.—The degree of orientation, as interpreted from the X-ray diagram, is a combination of the alignment of the crystallites within the individual fibres and the alignment of the fibres in the sample. Since it is impossible to separate these two major variables, it is imperative, in comparing the orientation of two cottons, to have the samples for X-ray examination prepared in a uniform manner. Because of the irregular twists and other imperfections in cottons, it is difficult, if not impossible, to mount the fibres in a perfectly parallel condition to insure that only the alignment of the fine structure of the fibre is being measured. The best that can be done in comparing the orientation of cottons is to be sure that the fibres are mounted as parallel as possible by a uniform method which can be duplicated. From a theoretical standpoint, the lack of strictly parallel fibres complicates the interpretation of the X-ray diagram, but from a practical standpoint it probably increases the value of the measurement, since the properties of a cotton fibre depend upon both its internal and external structure.

The samples for the present study were prepared in the fibre laboratories of the Division of Cotton Marketing by the improved Chandler bundle method,[4] except that a 2–3 millimeter section at the center, through which the X-ray beam passes, is left unwrapped. The fibres are combed parallel, made into bundles of uniform size, clamped in a wrapping device, and wrapped with No. 20 thread while held under a 10 pound tension. The bundle contains from 4,500 to 15,000 fibres, depending on the average fibre diameter, and approximately 25% of that number are exposed to the X-ray beam.

Exposure Conditions.—An exposure time such that the 002 diffraction ring at the intensity maxima has a density of 1.0 ± 0.25 was found to be the most satisfactory. If a density outside of this range is used there is an error introduced by the intensity-density relationship deviating from a straight line. In comparing a series of samples, the same pinhole system

was used with the X-ray tube operating at constant potential and current. The exposed films were developed for a definite time at 18° C. By adapting a standard sample, using a constant exposure procedure, and developing under uniform conditions, it was possible to produce a uniform background of the film and thus reduce the errors associated with correcting for this variable.

In order to keep the general blackening on the film to a minimum, it is necessary that the sample cover the entire opening of the pinhole system. Also, the X-ray beam must pass through the center of the bundle or the two sides of the diagram will be unequal in density. These conditions were fulfilled by a groove across the front of the pinhole system in which the sample is held by a suitable clamp.

The X-ray diagrams were made with unfiltered copper radiation ($\lambda = 1.54$ Å) produced in a Phillips' Metalix tube operating at 28 kilovolts and 25 milliamperes. Variations in line voltage were reduced to a minimum by the use of a stabilizer. The X-ray diagrams were registered on a flat photographic film placed 4 centimeters from the sample. A one-hour exposure, using 0.024 inch diameter circular slits placed 3 inches apart, proved satisfactory.

Density Measurements.—Previously,[5] it was suggested that density measurements be made every 5° or 10° around the diffraction ring, the measurements corrected for the general background of the film, the corrected values calculated to a relative or percentage basis, and the resulting distribution curves evaluated by statistical methods. This method is tedious and time consuming. Furthermore, after the distribution curves are obtained they are usually differentiated from each other in terms of some definite point on the curve; as, for example, the angle of one-half maximum density. In order to obtain this value, it is not necessary to go through the lengthy procedure of obtaining the complete numerical values for the density distribution. Measurements, such as the half maximum density value, can be obtained directly from the film.

To measure the angle of half maximum density, or any angle at which the density decreases a given per cent, the film is centered on the rotating stage, which in turn is centered with reference to the optical system of the densitometer, the 002 line being in focus. The density is read at one of the maxima; the photographic wedge is set at the desired fraction of this value; the stage rotated until the field is matched, and the angle of stage rotation noted. This is repeated on both sides of the two intensity maxima and the average of the four readings taken. The accuracy of the method can be increased by repeating the procedure for two different values at which the density decreases; for example, 50 and 75%. Representative values for the angle of 40% maximum intensity are listed in Table I.

Another rapid method for obtaining an index of orientation is to obtain the ratio of the density at the intensity maxima to the density at an angle of 30° or 40° from the maxima. This method is perhaps as sensitive as the method previously described, but the density of the film must be controlled within a fairly narrow range. To make the readings, the density is read at the intensity maxima 0°, the stage of the densitometer is then rotated 40° and another reading made. The value is then obtained by dividing the reading at 0° by that at 40°. This is repeated on both sides of the two intensity maxima and the average of the four readings taken.

A third method is to read the density at the maxima and minima and express the results as per cent orientation, similar to the method employed by Morey.[3] This method, however, due to the form of the distribution curve, was found to be not as sensitive as the other two methods when applied to the correlation of orientation and tensile strength of cottons.

Either of these three methods permits a measurement of orientation to be made from the X-ray film in 15 to 20 minutes, instead of the 1 to 2 hours formerly necessary[5] for obtaining complete density measurements and analyzing the results. The present results indicate that the orientation values obtained by these rapid methods are almost as precise as those obtained from the more complete measurements.[5] The more rapid methods are recommended for routine work, but the advantages of more complete measurements for careful research work are self-evident.

A microdensitometer of the "photographic wedge" type[5] was used in the present investigation. This type permits readings to be made rapidly and with a fair degree of accuracy. Furthermore, the readings can be duplicated and no adjustment of the instrument before making readings is necessary. It has the advantage over the automatic recording type of microphotometer in that the film is under observation while the measurements are being made. This arrangement enables one to be sure that the readings are made at the proper place on the diffraction ring, and to discard erroneous readings due to local imperfections in the film, or to the diffraction ring being off-center. The disadvantage of the "photographic wedge" type is the personal factor. This makes it necessary that the same individual make all the readings on samples which are to be compared. The amount of discrepancy introduced by different individuals working in different laboratories was not determined in the present investigation, but it probably accounts in part for the different equations relating the X-ray and tensile data for the two sets of 10 and 21 samples. The data for the 10 samples were obtained in the same laboratory by one person, while the 21 samples were photographed and measured on different instruments by different persons working in different laboratories.[5] More recently,[1] definite progress has been made in determining the precision of the method under different conditions, and a new more sensitive photo-electric densitometer developed for eliminating the personal factor.

In the previous paper[5] a correction was made for the film background. In making the more rapid measurements reported in this paper it was found that, if the exposure and developing conditions are uniform, it is possible to assume the general blackening of the film a constant and to obtain comparable results without the correction. Experiments on two sets of films showed, however, that the degree of correlation could be increased by correcting for the film background and a correction is necessary when comparing data obtained in two different laboratories.

Effect of Tension.—Holding the bundles under tension while they are photographed was found to improve the correlation between orientation and tensile strength. During the wrapping of the bundles they are held under a ten-pound tension. After the bundles are wrapped, and the tension removed, there is a tendency for the fibres to bulge at the unwrapped portion of the bundle, which slightly destroys the original alignment of the fibres. This original alignment can be partially recovered by the application of a tension to the bundle during exposure.

[5] The samples were photographed by Mr. O. C. Woodyard at the Division of Cotton Marketing, and the films measured by Mr. Howard Smith, Jr., at the Boyce Thompson Institute.

The series of samples photographed under tension showed considerable improvement in the correlation of X-ray and tensile strength data. The samples, however, were held in a clamp, which made it impossible to determine the exact tension applied to the bundle. It is probable that further improvement in correlation may result by the application of a definite measurable tension to each sample while it is being photographed.

Other variables.—In order to obtain more definite information regarding the exact relationship of orientation to tensile strength, it is obvious that further work must be carried out regarding the effect of different experimental conditions; such as preparation of sample, exposure conditions, measurement of density, and the method of expressing orientation.

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(*Continued from P. 424.*)

Textile Chemists and Colorists has inaugurated an improved and more convenient service to its members, and to other readers of its official organ who are interested in textile chemical research. The initial issue of the Quarterly Research Number contains two progress reports of the research on the chemistry of wool, one on the study of vat printing pastes, one on methods of determining oil, soap and other extraneous matter in textile materials, and five on the study of the mercerization process including a very complete bibliography of mercerization from Mercer's original patent in 1850 to the end of 1935, the latter compiled by Sidney M. Edelstein and William H. Cady. The Abstract Section of *Textile Research* will record brief reviews of these reports.

Abstracts

Committee on Abstracts and Bibliography:
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Address, C. H. Clark, Sec., 65 Franklin St., Boston, Mass.

I. Fibres (Synthetic and Natural) and Fibre Analysis

Light on Textile Fibres: Action of. M. J. Dumas. *Rev. gen. mat. color.*, 1937, V. 41, P. 149–53; abs. in *C. A.*, 1937, V. 31, Col. 4501.

A review is given of analytical methods for the detn. of the action of light on silk, wool and cotton. (W)

Protein Molecules: Structure. T. Svedberg. *Chemical Reviews*, 1937, V. 20, P. 81–98; abs. in *J. T. I.*, June 1937, P. A346.

A review is given of work on the structure of proteins by means of sedimentation velocity and sedimentation equilibrium methods in strong centrifugal fields, as well as by means of diffusion and electrophoresis determinations. A table of physical constants of protein molecules is presented, also a bibliography. (C)

Strength, Grade and Price of Egyptian Cottons. H. A. Hancock. *J. T. I.*, June 1937, P. T177–T187.

All the varieties composing the Egyptian crop are described, and their chief staple measurements and their yarn strength at a standard count are tabulated, from observed data on fully representative samples. The causes and effects of "grade" are discussed, and it is shown that the percentage of taker-in waste is a good index to grade if the variety is known. It is

shown that there is a close relationship between the yarn strength at a given count and the spot price of all kinds of Egyptian cottons. (C)

WOOL: COLLOID CHEMICAL BEHAVIOR. Haller. *Textilber.*, 1937, V. 18, P. 5–6; abs. in *J. T. I.*, June 1937, P. A298.

A review of methods of detecting wool damage and of decomposing wool into its histological constituents. By means of a highly concentrated pancreas gland preparation, supplied by Ferment A.-G., Basel, the author decomposed wool into its cortical cells. A diagram is given showing these on a microscopic slide. "Lanain," the cementing substance of the cortical cells (*J. T. I.*, 1936, P. A305), was dissolved or digested, thus destroying the bonds between the cells. (C)

WOOL: EFFECT OF SULPHUR CONTENT ON THE PROPERTIES OF. O. Routala and O. Kyllijoki. *Suomen Kemistelehti*, 1936, V. 9A, P. 49–53 (through *C. A.*, 1937, V. 31, Col. 2440); abs. in *J. T. I.*, June 1937, P. A333.

The S content of wool was determined by the method of Saarinen (see *Suomen Kemistilehti*, 1935, V. 8A, P. 44–5, 57–61). The authors found that fine wools had a higher S content and that there was a direct relation between strength and S content. Some S is lost in the washing and bleaching processes and the loss is greater with more alkaline solution and a higher temperature. To keep S losses at a minimum the solution should be acid as in the dyeing process. (C)

WOOL: VARIATION OF THE SULPHUR CONTENT OF. P. Larose and A. S. Tweedle. *Canadian J. Rsch.*, 1937, V. 15B, P. 124–31; abs. in *J. T. I.*, June 1937, P. A332.

The results obtained by other investigators which have a bearing on the variability of the sulphur content of wool are reviewed briefly. The variability of the sulphur content is discussed on the basis of the various factors that might affect it. The effect of light is appreciable and is a very important one. Any sulphuric acid formed by the action of light, or present owing to some other cause, is difficult to remove by ordinary washing. The effect of boiling water is small. Kempy fibres contain less sulphur than non-kempy fibres of the same wool. The root portions of fibres have a higher sulphur content than the tip portions, while middle portions have intermediate values. The writer's results and those of other investigators which are reproduced do not allow of any definite relation being drawn between sulphur content and fineness. (C)

X-RAY INVESTIGATION OF SERICIN. Y. Matsunaga. *J. Soc. Chem. Ind., Japan*, 1936, V. 39, Suppl. binding P. 465; abs. in *C. A.*, 1937, V. 31, Col. 4125.

Powder photographs were taken of (1) cocoons composed only of sericin, (2) silk gland, (3) powd. fibroin, (4) Kaneko's sericins *A* and *B*, (5) Watanabe's sericins (alc.-sol. and alc.-insol.), and (6) Mosher's sericins *A* and *B*. (6) *B* gave an X-ray photograph similar to (4) and (5). (6) *A* gave a new crystal photograph. Tables and figures are given in the Japanese paper. (W)

II. Yarns and Fabrics

Cause, Prevention and Removal of Spots in Textile Products. H. Günther. *Deut. Färber-Ztg.*, 1937, V. 73, P. 77–9; abs. in *C. A.*, 1937, V. 31, Col. 4127. (W)

Chemical Tests for Textiles. D. H. Phillips. *Chem. Age* (London), 1937, V. 36, P. 435–6; abs. in *C. A.*, 1937, V. 31, Col. 4821. Review with 60 references. (W)

Cops and Bobbins: Density. T. Haase. *Textilber.*, 1937, V. 18, P. 211; abs. in *J. T. I.*, June 1937, P. A305.

Yarns that are to be dyed in package form should be wound loosely on the bobbins or tubes. This is particularly important in the case of rayon and staple fibre yarns which swell more than cotton. Cops of which the volume expressed in cubic centimeters is about 2.5 times the weight in grams do not generally present difficulties in dyeing. Weights and dimensions of normal cops of cotton, wool and mixture yarns wound on perforated paper tubes are indicated. (C)

Endless Multi-ply Fabrics: Design. R. Werner. *Textilber.*, 1937, V. 18, P. 141–3; abs. in *J .T. I.*, June 1937, P. A310. (C)

Glycol Boriborate: Application in Sizing. *Monatsh. Seide u. Kunstseide*, 1937, V. 42, P. 84–7; abs. in *J. T. I.*, June 1937, P. A306.

The sizing of rayon, staple fibre and mixture yarns is discussed and the importance of the moisture content of the size on the material after drying is pointed out. The addition of hygroscopic materials, wetting agents, and alcohol to sizing materials is discussed. The advantages of the use of glycol boriborate are described and the results of breaking load and extension tests on viscose and cellulose acetate rayon yarns before and after sizing with this product are given. The possibility of using water-soluble cellulose derivatives as sizing agents is briefly discussed, and the application and advantages of synthetic wax emulsion sizes are described. (C)

Loom Sley: Technical Analysis of the Movement of the. Stephen Major. *Text. Rec.*, 1937, V. 54, No. 649, P. 31–2; abs. in *J. T. I.*, June 1937, P. A309.

An informative article on the eccentric movement of the sley and its necessity in power loom weaving. Diagrams show the resulting variation in eccentricity produced by altering the relative positions of the constituent parts. (C)

Non-slip Finish: Results of a. *Am. W. & C. Rptr.*, July 29, 1937, P. 19–20.

Compares regular with new type of finish on synthetic fabrics. Treatment with synthetic resin gives superior finish and reduces slippage. (C)

"RE-WEAVING" DAMAGED FABRICS. *Text. Rec.*, 1937, V. 54, No. 649, P. 52; abs. in *J. T. I.*, June 1937, P. A309.

A patent device, designed to overcome laborious hand darning of weft-damaged fabrics is discussed. It consists of two sets of metallic members controlling odd and even warp threads respectively, synchronized to produce crossed and open sheds alternately as in plain weaving, on depressing the control cams the weft being then inserted by hand. The device may be used on fabrics counting up to 120 ends per inch, and can also be employed for producing small sample pieces. To facilitate re-weaving of more complex patterns it is proposed to incorporate a pattern box in the commercial model of the darner. (C)

SHIRLEY OPENING MACHINES. T. C. Williams. *Tex. Wkly.*, 1937, V. 19, P. 399; abs. in *J. T. I.*, June 1937, P. A302.

A report of a lecture in which the application of stream-line air currents to the opening and cleaning of cotton is illustrated by reference to the Shirley Analyzer and Lint Recoverer. (C)

SILK BOLTING CLOTHS: WEAVING. J. Scott. *Silk J. Rayon Wld.*, 1937, V. 13, No. 153, P. 30; abs. in *J. T. I.*, June 1937, P. A308. (C)

SPINNING MILL: RATIONALIZATION. W. Bauer. *Textilber.*, 1937, V. 18, P. 193–4; abs. in *J. T. I.*, June 1937, P. A304.

The rationalization of textile processes is discussed and it is pointed out that indications of the directions in which improvements are required can be obtained from tests on the raw material, determinations of the strength and regularity of yarns, analyses of thread breakages in spinning and weaving and time studies of these processes. Typical figures are given. The relation between count and output in spinning is discussed and production numbers for ring spinning are given. Normal machine speeds and productions for opening and carding machines and drawing and speed frames are indicated. (C)

THREADS BREAK ON SPINNING MACHINES: FREQUENCY. F. Oertel. *Spinn. u. Weber*, 1937, V. 55, No. 7, P. 4–6; abs. in *J. T. I.*, June 1937, P. A303.

The causes and frequency of thread breaks on spinning machines and the method of determining the frequency of the breaks are briefly discussed. It is pointed out that in order to obtain a correct estimate of the frequency it is necessary to consider not only the number of breaks repaired by the operative in a given time but also the changes in the number of spindles running empty. An equation for the frequency of breaks is given together with curves showing the variations in breaks, piecings, and empty-running spindles in the course of spinning in a typical case. (C)

WIDE FABRICS: WEAVING ON NARROW LOOMS. *Tex. Wkly.*, 1937, V. 19, P. 441–3, 573; abs. in *J. T. I.*, June 1937, P. A308.

Point paper diagrams are shown for the weaving of a plain and a fancy cloth in two folds and a 2-and-2 twill in three folds. (C)

TWIN SLIVER DRAW FRAME. Casablancas High Draft Co. Ltd. *Text Rec.*, 1937, V. 54, No. 648, P. 51–2; abs. in *J. T. I.*, June 1937, P. A302.

The twin sliver draw frame produces a sliver twice as fine as normal draw-sliver frame and two of these are coiled together in each can. As a result only half as much draft is required at the speed frame and also only half the number of cans at the back, feeding the machine. The modification necessary to the ordinary draw frame is carried out only at the finishing head, and consists essentially in separating the sliver at the back of the machine into two groups of three or four slivers each. The fleece emerges from the front rollers separated, and passes through two condensing funnels and the calender rollers into the can in the usual way. The rotation of the cans imparts twist to the slivers, but in the twin sliver draw frame, the rotation of the can is reversed at regular intervals so that the sliver receives equal amounts of right-hand and left-hand twist. The twist in the sliver is, therefore, neutralized when this is subsequently pulled from the can at the speed frame. The use of this machine in combination with single process speed frames is discussed. (C)

WET STRENGTH OF VARIOUS MIXED SPUN FABRICS AS COMPARED WITH THAT OF A FABRIC MADE FROM PURE WOOL. G. A. Kohns. *Spinner u. Weber*, 1937, V. 55, No. 17, P. 1–2; abs. in *C. A.*, 1937, V. 31, Col. 4822.

The results of various tests show that textile fabrics manufg. from pure wool as well as those from mixed fabrics must be treated very carefully in the wet condition and must always be protected against excessive stresses. The statement cannot be justified that fabrics contg. mixed raw materials are inferior to pure wool in the wet state. Numerical results of various tests are given. (W)

WOOL-LANITAL BLENDS. P. Larose. *Canadian Tex. J.*, July 23, 1937, P. 32–3.

Describes method recommended by E. Da Schio (*Boll. assoc. ital. chim. tessile color*, 1936, No. 12, P. 180) for quantitative determination of Lanital in mixtures of wool-lanital. (C)

WOOL: SPINNABILITY. F. Calzone. *L'Ing. Text.*, 1937, No. 329, P. 51–66 (from *Boll. Laniera*, Sept. 1936); abs. in *J. T. I.*, June 1937, P. A331.

A method for the determination of the spinnability of wool involves determinations of the mean length and fineness of the fibre, the preparation of a roving of 10s count using drafts that do not exceed the mean length expressed in cm., determination of the exact count of this roving and calculation of the twist to be applied to it to produce an angle of twist of 63° 26′, determination of the strength of a sample with this twist, determination of the number of fibres in the cross-section of the thread, calculation of the number of contacts and the linear friction (ρ) on the mean length, and finally calculation of the degree of spinnability ϕ from the relation $\phi = 2.609\rho/r$, where r is the mean strength of the single fibre. The theory of the method is explained and formulae for the calculations are deduced. Examples are given and some general conclusions are outlined. (C)

III. Chemical and Other Processing (Not Otherwise Classified)

Textile Research: Influence of Changes in the Field of Chemistry on the Evolution of—and the Industrial Textile Evaluation. W. Schramek. *Monatschr. Textil-Ind.*, 1937, V. 52, P. 52–6; abs. in *C. A.*, 1937, Col. 3289. (W)

"Tylose" Finishing Agents: Application. K. Sponsel. *Textilber.*, 1937, V. 18, P. 100–102; abs. in *J. T. I.*, May 1937, P. A264.

Tylose products are water-soluble cellulose derivatives suitable for use in finishing processes. Tylose TWS may be used instead of starch for the finishing of cotton fabrics of medium and better quality, and also as a substitute for plant mucilages in filling finishes. Finishes which are fast to washing are obtained by padding with Tylose 4S and then passing through an acid bath. This treatment may be used instead of mercerization, or to increase the stability to washing of the lustre produced by mercerization, or to improve the wearing qualities of cotton, rayon and mixture fabrics, including knitted fabrics. Details of the methods of application are discussed and samples of cotton and rayon fabrics finished with Tylose TWS and 4S are given. (C)

Vat Prints: Development of. K. Heide. *Klepzig's Textil-Z.*, 1937, V. 40, P. 178–79; abs. in *C. A.*, 1936, V. 30, Col. 3241; 1937, V. 31, Col. 3281.

After the completion of the steaming the vat-dyed print goods are developed with chem. oxidizing agents. In practical work there is a great difference between the development of dyeings and printing. While in dyeing operations the oxidizing agents act principally upon the dye and only a slight residue is consumed by the other oxidizable chemicals present, the oxidation of vat prints involves not only the development of the leuco salts of the vat dyes in the goods but in addn. the complete removal of other printing constituents, particularly the thickened material. The standard H_2O_2, $NaBo_3$, Cr^- K, and Ondal development methods used in printing are described. Advantages of the Ondal method over the other methods are discussed. (W)

Weighting of Silk. H. J. Henk. *Mell. Textilber.*, 1937, No. 6, P. 451.

One of the chief reasons for the tendering of weighted silk is probably the property of trisilicate of tin in a colloidal state which permits of its redisposition in a crystalline modification, thereby bursting the fibre. That conversion is made possible and promoted by washing with alkaline solutions and by the action of heat and atmospheric oxygen. A number of compounds have been suggested with the object of getting rid of this drawback, most of them being reducing agents for which numerous patents have been granted. Thus the use of 1 to 2% or even weaker solutions of the following compounds has been proposed: sodium thiosulphate, ammonium formate, thiocyanates, aldehydes, aldehyde bisulphites, sulphocyanides, thiourea, hydroquinone, hydroxyl-amine salts, alkaloids, proteins, and Diastafor. These compounds have the property of stabilizing the colloidal state of

certain bodies, preventing them from crystallizing. Further, the pronounced reducing agents hinder oxidation and in that way make the fibre more resistant against the destructive effect of sunlight. (C)

WOOL CHLORINATION: STUDY OF. E. Justin-Mueller. *Rev. gén. mat. color.*, 1937, V. 41, P. 78–86; abs. in *C. A.*, 1937, V. 31, Col. 3289.

Wool, chlorinated industrially, by reason of the metakeratin transformation on its epithelial surface, acquires definite, specific qualities in respect to hydroactivity, permeability, absorption, resistance and inertness, which in their composite cannot be obtained to the same degree by any other treatment or process. Drawings are shown of photomicrographs of wool fibres treated with Cl, O in excess, vaporized bisulfite and with NaOH. It is only after 5 min. of chlorination that the epithelium appears partially attacked. The reactions that take place between the labile S of wool and the reagents, phosphoric acid, Cl compds., bisulfite and H_2O_2 are discussed. More complete elimination of the labile S is obtained with H_2O_2 than with bisulfite of Cl compds. Treatment with metathionyl chloride forms a mol. condensation covering the filament, increasing its resistance to hydrolyzing action. Fourteen references. (W)

WOOL: EFFECT OF DYEING ON THE STRENGTH AND SPINNING PROPERTIES OF. H. R. Hirst and P. E. King. *J. Soc. Dyers Col.*, May 1937, P. 198–202.

Reported results of experimental work on the effect of dyeing upon the spinning of carded-woolen yarns are inconclusive in large part, but emphasize the need of further work, and this has been undertaken on the effect of dyeing on the spinning of worsted yarns. (C)

WOOL: USE OF FAST-COLOR REDS ON. E. Justin-Mueller. *Teintex*, 1937, V. 2, P. 75–7; abs. in *C. A.*, 1937, V. 31, Col. 3282.

A brief historical survey of the subject is followed by a discussion of the essential distinction between the use of fast-color reds, scarlet or alizarin on cotton, and on wool. It is found that wool has a sufficient absorbing and dissolving power to combine and fix the alumina, whereas on cotton it is necessary to use a fatty substance in sufficient quantity for the purpose. The difference of penetration of the red dye into the two types of fibres is caused by the different capacity for alumina absorption. Three references. (W)

X-RAY INTERPRETATION OF PROTEIN STRUCTURE. W. T. Astbury. *Chem. & Ind.*, 1937, V. 56, P. 338; abs. in *J. T. I.*, May 1937, P. A292.

Thirty-seventh Bedson Lecture, March 1937. The X-ray structure of the fibrous and globular proteins is explained. (C)

IV. RESEARCH METHODS AND APPARATUS

COTTON FABRIC: DENSITY DETERMINATION. P. Kober. *Textilber.*, 1937, V. 18, P. 36–7; abs. in *J. T. I.*, May 1937, P. A278.

The density or closeness of a fabric is defined as the ratio of the area covered by the constituent yarns to the total area. A method of calculating fabric densities from the diameters and numbers per cm. of the warp and

weft yarns is explained, and a table showing the diameters of cotton yarns of different counts is given. The densities of various types of cotton fabrics are given. (C)

MERCERIZED COTTON: TESTING. E. Liebmann. *Angew. Chem.*, 1937, V. 50, P. 157–64; abs. in *J. T. I.*, May 1937, P. A277.

The author describes at some length results obtained by various absorption methods (iodine, direct dyes) for the estimation of "degree of mercerization," and the influence of various factors on the dye affinity test. As a result he proposes a method in which the material is treated again with caustic soda of 10, 15 and 25% concentration and the affinity of the four specimens (one not re-mercerized) for Chicago Blue is measured. If the dye absorption is increased on re-mercerization with 10 or 15% alkali, the conclusion is drawn that the first mercerization was equivalent to a treatment with alkali weaker than 10 or 15% as the case may be. (C)

MICROSCOPE TECHNIC: IMPORTANCE OF MODERN—FOR THE TEXTILE INDUSTRY. A. Kufferath. *Monatschr. Textil-Ind.*, 1937, V. 52, Fachheft I, P. 29–33; abs. in *C. A.*, 1936, V. 30, Col. 8132; 1937, V. 31, Col. 3702.

A discussion with illustrations. (W)

NEW METHODS AND ASSISTANTS IN THE pH MEASUREMENT IN THE TEXTILE INDUSTRY. F. Schroeder. *Monatschr. Textil-Ind.*, 1937, V. 52, Fachheft I, P. 6–8; abs. in *C. A.*, 1937, V. 31, Col. 3702. (W)

NEW METHODS OF TEXTILE TESTING. H. Sommer. *Spinner u. Weber*, 1937, V. 55, No. 7, P. 1–4; abs. in *C. A.*, 1937, V. 31, Col. 3702. (W)

RÖNTGENOGRAPHIC STUDY OF NATURAL AND MECHANICAL DISINTEGRATION OF PLANT FIBRES. (German) L. Belenkyi and A. Bojarkin. *Tech. Physics of U. S. S. R.* (published by State Technical Theoretical Press, Leningrad), 1936, V. 3, No. 5, P. 441–64; abs. in *Cotton Literature*, Mar. 1937, P. 109, from *J. T. I.*, Jan. 1937, P. A36.

The authors have determined the angle of inclination of the spirals in the structure of fibres (a) by direct microscopic observation (the angle decreases towards the inner layers), (b) from the dimensions of the chords of the equaterial interferences in the X-ray diagram, and (c) for mechanically disintegrated fibres by the X-ray method. The following values are recorded: Ramie, (a) 6°, (b) 4.5°, (c) 7.3°; Cotton, (a) 23°, (b) 13–13.41°, (c) 11.53–12.40°; Flax, (a) 8°, (b) 4.27–5.22°, (c) 8.5–9°. The X-ray diagram is not affected by mechanical disintegration. Satin dyed aniline black does not show the interference characteristic of mercerized cellulose, and the micelle thickness is less. (C)

SPRAY TEST FOR EVALUATING WATER REPELLENCY. A. A. Cook and J. Zaparanick. *Am. Dye. Rptr.*, June 14, 1937, P. 323–25.

This method consists of spraying a weighed piece of the fabric (which has been processed with a water-repellent compound) under certain carefully controlled conditions, and then re-weighing to determine the amount of moisture which has been absorbed. The technique and method of interpreting results are described. (C)

STAPLE FIBRE: DETERMINATION IN MIXTURES. K. Schulze. *Monatsh. Seide u. Kunstseide,* 1937, V. 42, P. 52–55; abs. in *J. T. I.,* May 1937, P. A275.

A method for the quantitative determination of staple fibre in mixtures depends on dyeing with a dye having different affinities for the components of the mixture, separating the components mechanically with or without the aid of a microscope, and weighing. Suitable dyes for mixtures of cellulose acetate, viscose and cuprammonium staple fibres with cotton and wool are indicated; iodine-potassium solution is recommended for cotton-viscose or cuprammonium staple fibre mixtures. Notes are given on the selection of samples, the preliminary removal of dyes and sizing and finishing agents, and the procedure for separating the components. Some typical results are given and it is pointed out that, by comparison with the compositions given by the manufacturers, the errors do not generally amount to more than ½%. (C)

TESTING INSTRUMENTS AND AN IMPROVED RECORDING FIBRE TESTER: REVIEW OF. G. Osumi and E. Kato. *J. T. I.,* May 1937, P. T129–T144.

The authors have recently developed a new single fibre testing machine in an attempt to meet the objections to existing machines. In this paper a brief description with comments on each known type of fibre testing apparatus is first given. A full account of the construction and operating characteristics of the instrument is given. (C)

TUFT LENGTH MEASURED ACCURATELY WITH SIMPLE DEVICE. G. E. Hopkins and J. N. Dow. *Tex. Wld.,* May 1937, P. 87.

The ingenious instrument that is described and illustrated is adapted for the length measurement of the tufts or pile of carpets, rugs and other pile fabrics. It has been used for several months for quality control work at the Bigelow-Sanford Carpet Co., of which Mr. Hopkins is technical director and Mr. Dow his associate. Excellent correlation has been obtained with thickness measurements. Measurements are made easily at 120 per hour and rates as high as 142 per hour have been obtained. These figures include recording of the tuft identification, as well as the measurement. (C)

VISCOSE STAPLE FIBRE: COEFFICIENT OF FRICTION. H. Sobue. *J. Cellulose Inst., Tokyo,* 1937, V. 13, P. 3–11; abs. in *J. T. I.,* May 1937, P. A276.

The author records in tables the coefficients of friction, denier, length and cross-section dimensions of 20 brands of Japanese staple fibre. Coefficients of friction were measured by observing the angle of tilt necessary to cause a balance rider, 0.01 gm., to slide on the fibre when this was held under a tension of 0.7 gm. Fifty observations were made on each of 10 fibres and frequency curves are reproduced for all the 20 brands. The peak values are the angles recorded in the tables. (C)